2018 IMAG Futures Meeting – Moving Forward with the MSM Consortium (March 21-22, 2018)

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Title of Grant: Multiscale Modeling of the Brain: New Approaches to Model Axonal Bundle Physics for Injury, Rehabilitation and Beyond

Abstract Authors

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Abstract Text

This talk will focus on novel computational methods being applied to understand and model the neuronal tract bundle level in the brain. There will be two major parts of the presentation. The first revolves around continuum approaches to extend our modeling capability from the organ level (full brain) to the mesoscopic level of the brain – the level at which diffusion tractography can be used to describe the structural architecture. To bridge this gap, we have applied the embedded element method (**Figure 1a**) to model the axonal fiber tracts explicitly. An application of the method for modeling axonal injury will be discussed. The second part of the presentation involves beginning at the cell level and extending methods to reach up to the bundle level. The presentation will discuss techniques, currently under development, that capture bundle growth and the bioelectric response. The ultimate goal is to develop a simulation platform which can be used for the design and optimization of micro-tissue engineered neural networks in rehabilitation applications (**Figure 1b**).

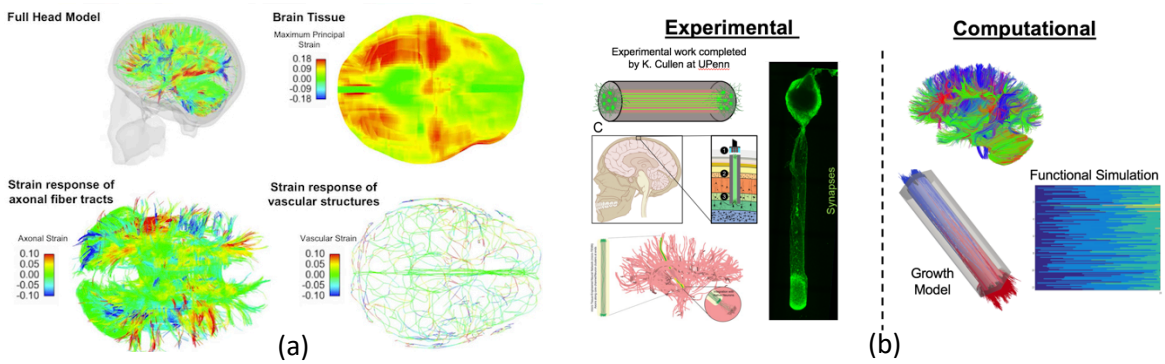

Figure 1. (**a**) Finite element model showing how embedded element method can be applied to included axonal fiber tractography and vasculature. (**b**) Computational framework for designing and optimizing micro-tissue engineered neural networks, which are similar to axonal bundle tracts.